IMPLEMENTATION OF GUIDELINES FOR ECO-LABELLING IN THE AGRI-FOOD SMEs: THE SICILIAN PISTACHIO SECTOR

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Abstract

This paper represents the practical implementation of some guidelines developed in the context of a published book entitled "*Product-Oriented Environmental Management System (POEMS). Improving Sustainability and Competitiveness in the Agri-Food Chain with Innovative Environmental Management Tools*".

Nowadays, companies show growing interest in the most suitable instrument of environmental communication for the characteristics of their products (and the related sector) could be. This aspect becomes particularly important in the agri-food compartment where the products features are the result of the interaction among very different subsystems, from the farming to the transformation and marketing processes. Over time, in this sector, a huge number of voluntary environmental labelling schemes systems, used as instruments of environmental communication, have sprung up. Consequently it becomes extremely difficult for the operators to choose the most suitable label for their needs.

In this context these guidelines were established with the aim of representing an innovative tool which, through the evaluation of key aspects of the environmental impacts of a product, can support the Small and Medium sizes enterprises (SMEs) in their choice of the most suitable environmental label for their own product; they can also enhance their communication strategies and their visibility in the market.

The company chosen for carrying out the implementation of these guidelines belongs to the Sicilian pistachio industrial sector and it is typical for its size and market within the Sicilian economic system. About 90% of the total Italian Pistachio area is concentrated in a few territories of Eastern Sicily, mainly located in the province of Catania (Bronte and Adrano).

Keywords: Agri-food chain, Ecolabels, Environmental Product Declaration, Sicilian Pistachio Sector

1. Introduction

Nowadays it has become clear that the purchase decisions taken by consumers for satisfying their needs can have a strong impact on the environment. In particular the choice of

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more sustainable products, in other words products providing environmental, social, and economic benefits while protecting public health and environment over their whole life cycle (from the extraction of the raw materials until the final disposal), can certainly be decisive in terms of impacts reduction.

At the same time, from the companies' perspective, the consumers' orientation toward more eco- friendly products is a powerful incentive. Companies are, in fact, motivated to find more sustainable ways of production for improving products' performance throughout their life cycle and to intensify efforts at environmental management level (Udo de Haes et al., 2010).

All that considered, it is important to give consumers the suitable tools for making correct purchase choices such as, for example, accessible, understandable, relevant, and credible information on the environmental quality and performance of the products. In this context, along the decades, the European action lines within the Sustainable Production and Consumption (SPC) strategy have been based on innovative tools able to develop the capability of producers and consumers to make "sustainable" choices and to influence each other. These tools refer to Life Cycle Assessment (LCA) which represents not only one of the fundamental methods for the Integrated Product Policy (IPP) realization but also the main operative instrument of the Life Cycle Thinking (LCT). Among these instruments, as also suggested by the Agenda 21, eco-labels can be considered as a mean for achieving this goal. In the last decades environmental labels and declarations gained attention at international level as a means for implementing a policy which can encourage producers to improving products' environmental performances (Clasadonte et al., 2013); at the same time, as reported by Hale (1996) and Wojnarowska (2014) the implementation of eco-labelling tools could lead to a change in the consumer's behavior connected to an increased ecological awareness. This awareness could be stimulated by the fair and reliable information regarding the product's environmental performances along its life cycle as an additional criterion to price and quality.

According to the ISO Standard 14020:2000 (ISO 14020, 2000), voluntary environmental labels and declarations aim at "encouraging the supply and demand for those products and services able to cause low damage to the environment so that it will stimulate a continuous environmental improvement process managed by the market". This standard identified three types of environmental labels and declarations: Type I (ISO 14024, 1999), for example the EU Ecolabel, the most widespread and well-known Type I label; Type II (ISO 14021, 1999), for example the "Mobius Cycle", related to the percentage of recycled material in a product; and Type III (ISO 14025, 2006), for example the International EPD® system, the most widespread and well-known Type III declaration; there is also another category, not regulated by ISO

standards, which has been defined as “environmental labels of Type IV”, for example the Forest Stewardship Council (FSC), Dolphin Safe, and Fair-trade Global labels.

Nowadays there is a growing interest from the companies on which the most incisive instrument of environmental communication suitable for the characteristics of their products (and the related sector) could be. This aspect becomes particularly important in the agri-food compartment where the products features are the result of the interaction among very different subsystems, from the farming to the transformation and marketing processes. Over time, in this sector a huge number of voluntary environmental labelling schemes systems used as instruments of environmental communication sprung up. Consequently it becomes extremely difficult for the operators to choose the more effective label suitable for their needs. Hence it follows the need to realize some guidelines which, considering the peculiarities of the soil, the specificness of the products, the characteristics of the supply chain, of the company operative context, and of the final reference markets, can be of some help in giving the firm a way to choose the more adequate environmental label for their agricultural and food products and which allow to bring out its communication strategies and the visibility on the market.

The development of this paper arises just from these considerations and it represents the practical implementation of some guidelines developed in the context of a published book entitled “*Product-Oriented Environmental Management System (POEMS). Improving Sustainability and Competitiveness in the Agri-Food Chain with Innovative Environmental Management Tools*”.

In this case, the company chosen for carrying out the implementation of these guidelines belongs to the Sicilian pistachio industrial sector and it is typical for its size and market within the Sicilian economic system.

It is important to underline that about 90% of the total Italian Pistachio area is concentrated in a few territories of Eastern Sicily, mainly located in the province of Catania (Bronte and Adrano). Recently the production of the Sicilian pistachio has had a re-launching in terms both of an increase in the number of companies, as well as an increase in the number of companies involved in transformation, with an increasingly concentrated specialisation, of the latter, besides the diffusion of associations between producers of semi-finished products. Besides, the demand for pistachio nuts has undergone, moreover, a significant increase, pushing many countries to invest in the production of this fruit and in its cultivation. The result is that the Bronte pistachio , for its special qualities, has acquired the protected designation of origin (PDO) “Green Pistachio of Bronte”, reserved only for the quality of pistachios that comply with the conditions and the European community’s established requirements of the Council Regulation (EC) No. 510/2006 (Council Regulation (EC) No. 510/2006) ,which has recognised it as PDO.

2. The production chain of the Bronte Pistachio and its characteristics

Pistachio, from the Greek word *Pistàkion*, is a plant that is found in the Mediterranean area and its seeds are used for very different purposes: direct consumption or they are sought after by confectioners or for flavouring cold cuts (Woodroof, 1967). Grown first by the ancient Jews, who believed the fruit to be precious, the pistachio nut quickly spread to Eastern populations as a plant with medicinal properties, a strong aphrodisiac and an antidote for poisoning; around 77 BC its cultivation spread in Italy, in particular to Liguria, Apulia, Campaniam, and Sicily.

Starting from 900 BC, the Arabs, who landed in Marsala (Sicily), began growing it (Fabbri and Valenti, 1997; Insero, 2014). They found the soil more fertile and in particular on the slopes of Mt. Etna, in the territory of Bronte where the plant grown in the lava ground was constantly fertilised by volcanic ash, and gave origin to a special fruit for its taste and smell, of a clearly superior quality (also from a functional point of view) to the rest of production worldwide.

Pistachio nuts are known to have a high content of polyphenols, e.g. anthocyanins, flavonols, proanthocyanidins, isoflavones etc., that are all potent antioxidants and that may have protective effects against diseases related to free radical overproduction, such as cardiovascular diseases and cancer (Bonina et al., 2000; Briamonte, 2005; Hou et al., 2004; Hu and Willett, 2002; Lo Giudice et al., 2011; Ros, 2009; Seeram et al., 2006; Tomaino et al., 2010; Zafra-Stone et al., 2007; Wang and Stoner, 2008; Yang et al., 2009). Some studies had underlines that there are some particular characteristics of Bronte pistachios, such as the presence of a number of bioactive compounds never identified in pistachios until today; furthermore the peculiar antioxidant power of pistachio skins has been clearly shown. There is much evidence that polyphenolic antioxidants from fruits and vegetables play an important role in the prevention of cancer, inflammatory activities and cardiovascular disease. In this context, introduction of pistachios in daily diet may be of undoubted utility in the protection of human health and well-being. Other studies evidence that the beneficial effects of this food might be optimized by consumption of the unpeeled nuts; on the other hand they suggest that pistachio skins, as a significant by-product of pistachio industrial processing, could be successfully employed in food, cosmetic and pharmaceutical industry (Bellomo et al., 2007; Gentile et al., 2007; Tomaino et al., 2010).

Chemical studies on pistachio kernels mainly regarded the fatty acids and sterols content (Arena et al., 2007; Okay, 2002; Venkatachalam and Sathe, 2006); other studies concern the

kernel pigments characterisation (Bellomo and Fallico, 2007; Giuffrida et al., 2006), the resveratrol recovery in seeds (Gentile et al., 2007; Grippi et al., 2008; Tokusoglu et al., 2005) and the presence of anacardic acids in the outer green shell (Saitta et al. 2009; Yalpani and Tyman, 1983).

The typicalness of this production with unique characteristics in the world – not incidentally "green-gold" is spoken of – has allowed the companies of transformation to distribute their derived products to all markets, national and international. Nowadays, consumers in the most advanced countries have increased their consumption of pistachio nuts, increasing demand both for the fruit itself as well as its side products (Bellia et al., 1988).

The territory of Bronte is home to 80% of the land surfaces investing in pistachio nuts in the province of Catania with 2,650 hectares of pistachio groves, of which 2,400 hectares of main cultivation. In this town a decrease has been noted in comparison to 1995, equal to 150 hectares, above all in the surface areas of the subsidiary companies (-37%) (Caruso and Motisi, 1996; Caruso et al., 2003).

From the analysis of the provincial data it is evident that in Sicily the largest contribution is given by the province of Catania which with 1,093 tonnes in the period 2002/2005, holds more than 85% of regional production; even so it should be pointed out that there is a noticeable drop in production, in comparison to the previous four year period during which more than 1,800 tonnes of pistachio nuts were produced, equal to 91% of the total for the Island. Today the quota of sales of transformed pistachio nuts absorbs 60% of production and a good 4,000 hectares of lava ground of the 25,000 hectares of the territory of Bronte are dedicated to pistachio groves (Buffa et al., 2007). As far as the varieties produced are concerned, the Sicilian pistachio cultivation is centred solely on the "Napoletana or Bianca"variety , which represents 96-98% of the companies and their related production; it is the only cultivar widely utilized both in the "natural" or in the regular plantations and Terebinth is the only rootstock (Barone et al., 1997), Bianca tree can be defined of low-intermediate vigour. Growth habit is spreading; branching habit is intermediate. The harvesting of the Bronte pistachio is biennial and is done in odd numbered years, between the end of August and the beginning of September and every plant produces from 10 to 30 kilograms of fruit.

The picking is done totally by hand directly from the trees, making the fruit simply fall into a container carried on the picker's shoulder or by shaking the branches of the trees to collect the fruit on sheets spread at the feet of the trees or, in some cases , also by using an upside down umbrella. After the fruit is harvested it is hulled, or rather separated from its hull, the leathery wrapping which covers it, by a mechanical scrubbing and, afterwards , dried for 3-4 days in the sun in large open spaces. In this way, the pistachio nut in its shell is obtained, locally called the

“Tignosella”, which is stored by the producers in dark dry places, awaiting to be sold. The shelling, or rather the removal of the woody shell, is the next step; the cooperatives or local tradesmen who buy the product deal with this operation (Leone, 1969).

The peeling, or rather the removal of the endocarp (thin layer of purpley-red coloured skin which covers the fruit) is done by a highly technological process, after a brief steaming of the fruit at high temperatures which causes the endocarp to detach itself from the fruit. By the rubbing on the rollers of the peeling machine, at varied speeds, the detached film is removed. Then, the pistachio nuts pass through a complex circuit of desiccation at low speeds and from this to the electronic selectioning machine that eliminates possible nuts that are not dark green; the dried product is, then, packaged in wrappings of various materials (La Russa et al., 2006; La Russa et al., 2007).

Despite of the increase in demand, the production chain of pistachio nuts in Sicily does not have a solid basis, given that the pistachio nut growers continue to keep production prices high and sale prices are not very profitable; all this means low profit margins for the farming companies.

In recent years, the institutions have given financial aid to the producing companies (PAC, biological). The first step in this direction was made on 3rd November 2004 when 30 producers and businesspeople set up the “Safeguarding Consortium” also having the function to exploit a product which has special features closely linked to the geographic area of origin and that seems threatened by the importing of lower quality pistachio nuts (in March 2004 the Ministry of Agricultural Policies and Forestry published a law that included the “the provisional agreement of Protection on a national level for the designation of “the Green Pistachio of Bronte”).

In particular, the Protected Designation of Origin (PDO) “the Green Pistachio of Bronte” is reserved for the pistachio nut that complies with the conditions and requirements established by the Council Regulation (EC) No. 510/2006; it deals with the “ *product, shelled , unshelled or peeled, of the botanical plant species “Pistacia vera”, cultivar “Napoletana”, also called “Bianca” or “Nostrale”, grafted on “Pistacia terebinthus*“ the Green Pistachio of Bronte” PDO. In this context, every stage of the production process is monitored and documented, and the cadastre lots where production takes place are registered in lists provided for the purpose, run by the controlling structure and, in this way, the traceability of the product is guaranteed. In particular, the registration in the list of producers implies the allocation of an identifying code by which both the manager and the related pistachio grove can be identified (Production ruling "Green Pistachio of Bronte” Protected Designation of Origin). All the people, physically or legally, registered in the relative lists, are subjected to the “Green Pistachio of Bronte” PDO (in

Fig. 1 the logo is reported) which in order to be eligible for marketing must have, besides the normal requites of quality, other special physical and organoleptic features: dark green colour of the cotyledons, ratio of chlorophyll a/b between 1.3 and 1.5; strong aromatic taste, without any hint of mould or strange flavours; humidity content between 4% and 6%; ratio of length/width of the nut between 1.5 and 1.9; high content of monounsaturated fats in the fruit (Barone and Marra 2008).

Fig. 1. The logo of Protected Designation of Origin PDO

The production area falls in the territory of the towns of Bronte, Adrano , Biancavilla and is characterised by land of volcanic origin and by a subtropical, semi-dry Mediterranean climate with long, arid summers, rainfall concentrated in the autumn and winter periods and significant temperature ranges between day and night. The ground comes from lava formations, having a good fertility and neutral pH, which are suitable for the vegetative development of the pistachio nut, as are the surrounding areas of a autochthonous nature (Barilaro, 2006).

The pedo-climatic peculiarity and the techniques of de-gemmation used in the area of production, permit the natural rotation of the species to be emphasized, and to get advantages from the plants' protection (Barilaro, 2007; Pellegrino Faro, 2007). These pedo-climatic factors give the fruit particular characteristics of quality (the dark green colour typical of the territory, the elongated shape, aromatic flavour and high content in monounsaturated fatty acids of the fruit) that identify the "Green Pistachio of Bronte" PDO from the other pistachio nuts that come from other geographical areas (Maccarone, 2007). In particular the boundaries are identified in the territory of Bronte, to the West along the River Simeto, Adrano and Biancavilla.

3. The implementation of the guidelines for environmental labels in agri-food SMEs

In order to test the implementation of the guidelines for environmental labels and declarations in agri-food SMEs, a firm which operates in the pistachios chain was chosen as it was considered representative of the Sicilian economic system. After a brief description of the

sector and the pilot firm, the path followed by the firm towards the choice of a voluntary environmental labelling system which suited its peculiarities will be reported.

The company has drawn up the check lists reported the guidelines (Clasadonte et al., 2013), with the aim of furthering its knowledge and the sensitivity of the organization to environmental issues and of identifying the environmental impacts produced during the various phases of the productive process. In the following box there is a brief description of the pilot firm, subject of the study case.

Marullo s.p.a.

The Marullo trademark was born in 1960. The present state of this enterprise is the result of experience and tradition which have been handed down from generation to generation for over 50 years. Marullo have always marked dried fruit, in particular pistachios fruit. The plant is located in Bronte, in East of Sicily and covers an area of about 10,000 m2, 3,000 m2 of which is covered. Today the farmhold is managed by the third generation and the traditional methods adopted by the grandfather have been improved by new productive systems which respect both the environment and the consumer. The Marullo is today a modern and avant-garde for the selection and processing dried fruit, has long established itself in Italy and abroad the export of finished and semi-finished products sweet confectionery.

Each product may also be packaged and 'custom' tailored customer needs.

The productive chain meets all the law requirements, respects all health and hygiene standards including the internal control standards for food companies (HACCP) and the recent standard relating to chain traceability; moreover it has quality voluntary certification as international laws ISO 9000:2008. In these last years, thanks to the Marullo trademark, the farmhold has consolidated the Sicilian market and it has been planning to expand abroad, looking at the international market.

Products

- Crumbles
- Dried fruit
- Pistachio natural colored paste
- Pistachio natural pure paste
- Hazelnut clear pasta
- Pine clear pasta

Marullo factory has the following certifications:

- BRC (British Retail Consortium)
- Green Pistachio of Bronte Protected Designation of Origin (PDO)
- FS (International Food Standard)
- HALAL

The company has drawn up the check lists reported in the guidelines, “Starting evaluation of the firm”, with the aim of furthering their knowledge and the sensitivity of the organization to environmental issues and of identifying the environmental impacts produced during the various phases of the productive process. In particular table 1 reports on the main information collected by the firm.

As far as the environmental policy of the firm is concerned, from discussions with the management, it emerged that Marullo should have an environmental policy coherent with ISO 14020 (2000) and the ISO 14063 (2010) set of standards which, in the literature, are the reference international regulations. The foremost objectives of the company should be: to encourage suppliers to adopt more sustainable farming production systems; to enrich the knowledge of its consumers regarding eco-compatible reduction; to prevent and reduce environmental impacts connected with the company productive cycle; to implement a system of integrated medium-term management, to use high quality raw materials, internal audit to measure environmental performance, continuous improvement in customer satisfaction, to improve green marketing through consumers very sensitive to environmental issues, finally training allows workers to learn the proper use of equipment, machinery and plant.

Regarding the environmental communication policy, the management has decided to control periodically the procedures and the results of the company’s environmental performance in accordance with the legally binding requisites; it has also decided to make all the necessary improvements in order to reach the environmental aims described above, thus ensuring the continuous improvement of the company at large, and to communicate its commitment to consumers and stakeholders.

Table 1. Company check list process

Data	***Answers***	***Data***	***Answers***
Name	Marullo s.p.a.	Label	In accordance with the law
Legal form	Limited Company	Distribution net	- wholesalers (other)

Sector	Dried fruit	Types of packages	- PP - Carton
Site	Bronte (CT), Italy	Difficulties to carry out the legally binding standard in the agri- food sector	NO
Employees	10	LCA study	NO
R&S in QES	YES	Voluntary certifications	- BRC - IFS ISO 9000 PDO - HALAL
Request for certified products	YES	Knowledge of voluntary environmental labels	Type I, II, III, IV
Customers' environmental sensitivity	YES	Renewable energy sources	YES- solar panels
Steps of the productive cycle (internal)	- harvesting; - hulling; - shelling - pelling - drying process; - packaging; - storage ; - distribution;	Steps of the productive cycle (external)	- First activity: conventional
Main environmental impacts	- material waste packaging - energy consumption		

Moreover, to promote this policy, the management pointed out the appropriate financial, human, technical and structural resources with a view to putting into practice programmes of technological development within the company and monitoring the effectiveness of the communication system set up. The management decided that the company strategy of environmental communication had to include the identification and quantification of the different environmental impacts connected with the different steps of the productive process; moreover, from the analysis of the specially carried out market research, it emerged that the reference target group for the company seemed to be mainly composed of the current end-consumers, who were more or less sensitive to environmental issues, distribution operators of the pasta product and other consumers, including foreign ones, who would remain loyal to the firm if it adopted proper environmental communication systems (Salomone et al., 2011; Salomone et al., 2012).

The main company environmental impacts have been not pointed out, Through analyzing the life cycle Analysis of the entire productive chain (from the farming to the final consumption

by the end-user and the disposal of the packages), and it is necessary to detect besides the high energy and thermal consumption during the entire production process and to quantify the most important indicators of the environmental performance detected during the company's environmental evaluation.

The information collected by the firm, subject of this case study, was integrated with the decision support tables given in the Guidelines: it emerged that the voluntary labelling system most in line with the organizational, environmental and economic characteristics of the company was Type I "LCA Eco-labels (ISO 14024)": these labels are generally voluntary, multi-criteria based, third-party verified schemes that award a licence to use the scheme label/logo for specific products or services that meet prescribed standards based on a life cycle assessment approach including, for example, energy and water consumption, emissions, disposal, etc. The standards and scheme criteria are usually developed through the involvement of stakeholders and awarded after an independent process of verification.

4. Conclusions

The experience resulting from the application of the guidelines proposed to the firm has shown how it is possible to choose the voluntary communication system, closer to the business reality, by starting from the analysis of the company activities and of the expectations of the management, the stakeholders and their environmental awareness. The guidelines take into account the peculiarities of the soil, the specific quality of the products, the characteristics of the supply chain and of the company operative context and the final reference markets. They are derived from objective environmental assessments, so during the application phase they could make the management more aware of a higher control of the productive processes and of a more responsible management of all the company activities thus making sure production improves continuously in terms of environmental performance.

Following the iterative procedural steps and making use of decision support instruments, the organization has achieved the aim of giving to its distributors and consumers the necessary information for a conscious choice of eco-compatible products; it has also given the relevant information connected with the phases of the productive process, the product itself and the performance in terms of environmental impact. By choosing the most suitable environmental label, the pilot firm can improve its production chain drive within the limits of sustainability, also because the success of any environmental label mostly depends on the level of consumer awareness.

The firm has decided the environmental communication goals with own environmental communication policy which an organization sets up as part of its environmental communication strategy, such as helping organization framework for implementing its environmental communication policy and for the setting of environmental communication objectives and targets. The label could improve also the green marketing, instruments based on strategic incentive and on competitiveness, which are extremely important for the firms which base their communications on the strong and concrete improvement of their own environmental performances and which try to meet the increasing sensitivity of the consumer to environmental defence.

References

Arena E., Campisi S., Fallico, B., Maccarone, E., (2007), Distribution of fatty acids and phytosterols as a criterion to discriminate geographic origin of pistachio seeds, *Food Chemistry*, **104**, 403–408.

Barilaro C., (2006), *Pistachio, the "Green Gold" of Etna. A Symbiosis between Nature and Culture (Il pistacchio, "oro verde" dell'Etna. Una simbiosi tra natura e cultura),* In: *Landscapes, values and Flavours (Paesaggi, valori e sapori),* Grillotti M.G., Borghese A., Esposito G., Lodi M., Mastrobernardino L., (Eds.) WIP Edizioni, Rome, Italy.

Barilaro C., (2007), *The "Emerald" Etna between Local Identity and Global Challenges (Lo "Smeraldo" dell'Etna tra Identità locale e Sfide Globali*), In: *The Future of Geography: Environment, Culture, Economy (Il futuro della geografia: ambiente, culture, economia),* Di Blasi A. (Ed.), Vol.1, Patron Editore, Bologna, 219-226.

Barone E., Marra F., (2008), *The Pistachio Industry in Italy: Current Situation and Perspectives,* World Edible Nuts Economy, Concept Publishing Co.

Barone E., Padulosi S., Van Mele P., (1997), *Descriptors for Pistachio (Pistacia vera L.),* International Plant Genetic Resources Institute, Rome, Italy.

Bellia F., Maugeri G., (1988), *Economic Aspects of the Production and Market of Pistachio (Aspetti economici della produzione e del mercato del pistacchio),* Proc. of the Conference *Current and Prospects of Pistacchicoltura* (Atti del convegno Attualità e prospettive della pistacchicoltura), September 6th-8th, Bronte (Italy), University of Catania, Italy.

Bellomo M.G., Fallico B., (2007), Anthocyanins, chlorophylls and xanthophylls in pistachio nuts (Pistacia vera) of different geographic origin, *Journal of Food Composition and Analysis*, **20**, 352–359.

Bonina F., Puglia C., Tomaino A., Saija A., Mulinacci N., Romani A.., Vincieri FF., (2000), In vitro antioxidant and in vivo photoprotective effect of three lyophilized extracts of Sedum telephium L leaves, *Journal of Pharm Pharmacol,* **52**, 1279–1285.

Briamonte L. (Ed.), (2005), *The Sector of Nuts in Italy (Il comparto della frutta in guscio in Italia),* INEA, Roma.

Buffa R., La Mantia M., Marra F. P., Cutuli M., Caruso T., Spata P., (2007), Rese dei pistacchieti etnei a rischio per il poco polline, *L'Informatore Agrario*, **39**, 26.

Caruso T., Motisi A., (1996), Development opportunities in the South of pistacchicoltura: technical and production guidelines (Possibilità di sviluppo della pistacchicoltura nel Mezzogiorno: indirizzi tecnici e produttivi), *Magazine of Fruit and Vegetable Producers (Rivista di frutticoltura e di ortofloricoltura),* **1**, 9-17.

Caruso T., Barone E., Marra F.P., Sottile F., La Mantia M., De Pasquale C., (2003), *Effect of Rootstock on Growth, Yield and Fruit Characteristics in cv. Bianca Pistachio (Pistacia vera L.) Trees*, Proc. XIII GREMPA Meeting on Almonds and Pistachios, 1-5 June, Mirandela, Portugal.

Clasadonte M.T., Lo Giudice A., Matarazzo A., (2013), *Environmental Labels and Declarations in the Agri-Food Sector,* In: *Product-Oriented Environmental Management Systems (Poems): Improving Sustainability and Competitiveness in the Agri-Food Chain with Innovative Environmental Management Tools*, Salomone, R., Clasadonte, M.T., Proto, M., Raggi, A. (Eds.), Springer, The Netherlands, 177-201.

Council Regulation (EC) No. 510/2006 of 20 March 2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs, *Official Journal*, No. 93 of the 31st March 2006.

Fabbri A., Valenti C., (1997), The Sicilian Pistachio industry: an overview, *Acta Horticulturae*, **470,** 43- 49.

Gentile C., Tesoriere L., Butera D., Fazzari M., Monastero M., Allegra M., Livrea M.A., (2007), Antioxidant activity of Sicilian pistachio (Pistacia vera L. var. Bronte) nut extract and its bioactive components, *Journal of Agriculture and Food Chemistry*, **55**, 643-648.

Giuffrida D., Saitta M., La Torre L., Bombaci L., Dugo G., (2006), Carotenoid, chlorophyll and chlorophyll-derived compounds in pistachio kernels (Pistacia vera L.) from Sicily, *Italian Journal of Food Science*, **18**, 309–316.

Grippi F., Crosta L., Aiello G., Tolomeo M., Oliveri F., Gebbia N., (2008), Determination of stilbenes in Sicilian pistachio by high-performance liquid chromatographic diode array (HPLC-DAD/FLD) and evaluation of eventually mycotoxin contamination, *Food Chemistry*, **107**, 483–488.

Hale M., (1996), Ecolabelling and cleaner production: principles, problems, education and training in relation to the adoption of environmentally sound production processes, *Journal of Cleaner Production*, **4**, 85-95.

Hou D., Kai K., Li J., Lin S., Terahara, Wakamatsu M., Fujii M., Young M.R., Colburn N., (2004), Anthocyanins inhibit activator protein N.1 activity and cell transformation: structure-activity relationship and molecular mechanisms, *Carcinogenesis* , **25**, 29-36.

Hu F.B., Willett W.C., (2002), Optimal diets for prevention of coronary heart disease, *Journal of American Medical Association*, **288**, 2569-2578.

Insero O., (2014), Pistachio, long-lived tree that requires hot climates (Pistacchio, albero longevo che esige climi caldi), *Agrarian Informer (L'informatore agrario)*, **07-08**, 30.

ISO 14020 (2000), Environmental labels and declarations - General principles, Technical Committee ISO/TC 207, Environmental management, Subcommittee SC 3, Environmental labelling, On line at: http://www.iso.org/iso/catalogue_detail?csnumber=34425.

ISO 14021, (1999), Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling), On line at: http://www.iso.org/iso/catalogue_detail.htm?csnumber=66652.

ISO 14024, (1999), Environmental labels and declarations. Type I environmental labelling. Principles and procedures, On line at: http://www.iso.org/iso/catalogue_detail?csnumber=23145.

ISO 14025, (2006), Environmental labels and declarations. Environmental labels and declarations -- Type III environmental declarations - Principles and procedures, On line at: http://www.iso.org/iso/catalogue_detail?csnumber=38131.

La Russa E., Barone E., Marra F. P., Caruso T., Finoli C., Mineo V, (2006), Seafood pistachio compared in storage phase (Frutti di pistacchio a confronto in fase di conservazione), *Agrarian Informer (L'Informatore Agrario)*, **27**, 25-29.

La Russa E., Marra F. P., Caruso T., Finoli C., Mineo V., Pulvirenti G., (2007), The automated drying maintains the quality of pistachio (L' essiccazione automatizzata mantiene la qualità del pistacchio), *L'Informatore Agrario (Agrarian Informer)*, 22-25, On line at: http://www.agrinnovazione.regione.sicilia.it/rassegna_stampa/frutta_secca/file/l_essiccazione_automatizzata_mantiene_la_qualita_del_pistacchio.pdf.

Leone G., (1969), *The Cultivation of Pistachios (La coltivazione del pistacchio)*, Paruzzo, Caltanisetta, Italy.

Lo Giudice A., Clasadonte MT., Matarazzo A., (2011), LCI preliminary results in the sicilian durum wheat pasta chain production, *Journal of Commodity Science, Technology and Quality*, **50**, 65-79.

Maccarone E., (2007), Improvement and development of fruit production of Etna (Miglioramento e valorizzazione delle produzioni frutticole etnee), *Agrarian Informer (L'Informatore Agrario)*, Supplement of Sicily - Innovation Agribusiness **(**Supplemento Sicilia - Innovazione agroalimentare), **27**, 40-46.

Okay Y., (2002), The comparison of some pistachio cultivars regarding their fat, fatty acids and protein content, *Horticultural Science (Gartenbauwissenschaft)*, **67**, 107–113.

Pellegrino Faro I., (2007), *L'oro verde di Sicilia: percorsi storico–gastronomici sul Pistacchio*, Il lunario Enna, Italy.

Ros E., (2009) Nuts and novel biomarkers of cardiovascular disease, American Journal Clinical *Nutrition*, **89**, 1649-1950.

Saitta M., Giuffrida D., La Torre G., Potortì A. G., Dugo G., (2009), Characterisation of alkylphenols in pistachio (Pistacia vera L.) kernels, *Food Chemistry*, **117,** 451–455.

Salomone R., Clasadonte M T., Proto M., Raggi A., Arzoumanidis I., Ioppolo G., Lo Giudice A., Malandrino O., Matarazzo A., Petti L., Saija G., Supino S., Zamagni A., (2011), *Product-Oriented Environmental Management Systems (POEMS): Improving Sustainability and Competitiveness in the Agri-Food Chain with Innovative Environmental Management Tools (Proposta di un Modello di Product-Oriented Environmental Management System (POEMS) per l'industria Agro-Alimentare: Risultati Preliminari)*, Proc. 25th Italian Congress on Commodity Science: *The Contribution of Science Merchandise for a Sustainable World (Il contributo delle scienze merceologiche per un mondo sostenibile*), Campisi B., Novelli V. (Eds), FORUM Edizioni, Udine, Italy.

Salomone R., Clasadonte MT., Proto M., Raggi A., Arzoumanidis I., Ioppolo G., Lo Giudice A., Malandrino O., Matarazzo A., Petti L., Saija G., Supino S., Zamagni A., (2012), *Improving Life Cycle Management (LCM) tools for the food industry: a framework of Product-Oriented Environmental Management System (POEMS,)* Abstract book of the 6th SETAC World Congress, Berlin, Germany.

Seeram N.P., Zhang Y., Henning S.M., Lee R., Niu Y., Lin G., Heber D., (2006), Pistachio skin phenolics are destroyed by bleaching resulting in reduced antioxidative capacities, *Journal of Agriculture and Food Chemistry*, **54** , 7036-7040.

Tokusoglu O., Unal M.K., Yemis, F., (2005), Determination of the phytoalexin resveratrol (3,5,40-trihydroxystilbene) in peanuts and pistachios by high performance liquid chromatography diode array (HPLC-DAD) and gas chromatography–mass spectrometry (GC–MS), *Journal of Agriculture and Food Chemistry*, **53**, 5003–5009.

Tomaino A, Martorana M, Arcoraci T, Monteleone D, Giovinazzo C, Saija A. (2010), Antioxidant activity and phenolic profile of pistacchio (Pistacia vera L., variety Bronte) seeds and skins, *Biochimie,* **92,** 1115–1122.

Udo de Haes, H. A., de Snoo, G. R. (2012), *Eco-labelling of Agricultural Food Products*, In: *Environmental Assessment and Management in the Food Industry. Life Cycle Assessment and Related Approaches,* Sonesson U., Beril J., Ziegler F. (Eds.), Woodhead Publishing Limited, 374-397.

Venkatachalam M., Sathe S.K., (2006), Chemical composition of selected edible nut seeds, *Journal of Agriculture and Food Chemistry*, **54**, 4705–4710.

Wang L.S., Stoner G.D., (2008), Anthocyanins and their role in cancer prevention, *Cancer Letterature*, **269**, 281-290.

Wojnarowska M., (2014), *On Possible Application of the Product Life Cycle Analysis (LCA) in Environmental Labelling,* In: *Commodity Science in Research and Practice - Towards Sustainable Development*, Adamczyk, W. (Ed.), Foundation of the Cracow University of Economics, Cracow, 199-210.

Woodroof J.G., (1967). *Pistachio Nuts,* In: *Tree Nuts: Production, Processing, Products,* AVI Publishing, Westport, Conn, 261-287.

Yalpani M., Tyman J.H.P. (1983), The phenolic acids of Pistachia vera, *Phytochemistry*, **22**, 2263–2266.

Yang J., Liu R.H., Halim L., (2009), Antioxidant and antiproliferative activities of common edible nut seeds, *LWT-Food Science Technology*, **42**, 1-8.

Zafra-Stone S., Yasmin T., Bagchi M., Chatterjee A., Vinson J.A., Bagchi D., (2007), Berry anthocyanins as novel antioxidants in human health and disease prevention, *Molecular Nutritional Food Researches*, **51**, 675- 683.